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will separate it. The Central-American *subulata* resembles *nigrina* somewhat but differs in the more attenuated elytra, wider humeri and the elytral apices truncate with the sutural angle mucronate.

***Lebasiella mesosternalis*, new species.**

Form of *marginella* and *pallipes*; black; head, thorax, antennæ, except club, and median part of mesosternum red; elytra dark blue. Head and thorax moderately coarsely and densely punctate, clothed with erect dark hairs. Elytra coarsely and closely punctate; pubescence dark, short and erect as on thorax. Abdomen moderately coarsely and less closely punctate than the elytra. Length 4 mm.

Huachuca Mts., Arizona.

The blue, coarsely punctate elytra separates this species from *marginella* and *pallipes*; the shorter robust form and the narrower intermediate antennal joints which are similar to *marginella* and *pallipes* from the rest of our species.



STUDIES ON MYRMECOPHILES. II. HETÆRIUS.

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The myrmecophilous beetles of the Histerid genus *Heterius*, which are widely distributed over the north temperate zone, have attracted the attention of a number of entomologists. Lewis (1884) has described a couple of species (*H. gratus* and *optatus*) from the nests of Japanese ants. The common European *H. ferrugineus* has been briefly studied by Ernest André (1874), Escherich (1897), Forel (1874), Gradl (1879), von Hagens (1865, 1879), Janet (1897), Janson (1857), Lucas (1861), Marseul (1853-62), and Wasmann (1886, 1894, 1898), and several North African species have been described by Lewis (1888a, 1888b) and Thery (1897). Some attention has been paid to our North American *Heterii* by Brues (1903), Cockerell (1890), Fall (1907), Liebeck (1891), Schwarz (1889), and Wickham (1892).

Most of these authors, however, merely record the occurrence of the beetles with certain ants (in several instances inaccurately identified) but tell us nothing about their habits. Indeed, apart from their occurrence with certain hosts, the habits of all the species, except the

European *H. ferrugineus*, are unknown. We may, therefore, regard this form as the ethological type of the genus. In his "Verzeichniss" (1894), Wasmann has taken great pains to record the names of the host ants with which *ferrugineus* has been found, both by himself and earlier authors. The regular host is unquestionably *Formica fusca*, either alone or when living as an auxiliary, or slave with *F. sanguinea* or *Polyergus rufescens*. Less frequently the beetle occurs in the nests of other European species of *Formica*, several species of *Lasius*, *Tapi-noma erraticum*, *Myrmica scabrinodis* and *Leptothorax acervorum*.

Wasmann (1886) gives the following account of the behavior of *ferrugineus* in nests containing *fusca*: "I believe that the ants are quite indifferent to the beetle, as Forel, too, has remarked ("Fourmis de la Suisse," p. 426). According to my observations *Polyergus* pays no attention to it, and *fusca* little or none. The beetle, nevertheless, is continually foisting itself on the ants. It scampers about among them, climbing now on this individual, and over its back, now on that, and anon allowing itself to be carried along passively on some ant's back. It seeks out by preference the densest swarm of ants and climbs from one to another. *Polyergus* seems to be unaware of its existence. This ant neither starts nor moves her feelers or legs but behaves as if the *Hetærius* were not walking over her. Once only I saw a *Polyergus* throw the beetle off, but the latter had run over her clypeus just as she was about to clean her face with the strigil of her fore leg. When a *Polyergus* encounters the beetle she takes no notice of it, and this is usually also the case with *fusca*. Twice, however, I saw a *fusca* touch the beetle's head and thorax with her mouth, but I was unable to determine the nature of the contact as it lasted only a few seconds. It was certainly not accidental. During this encounter the beetle applied its legs to its body and remained motionless, but hurried away as soon as the ant withdrew her mouth. I repeatedly saw a *fusca* take notice of one of the beetles. She approached it slowly, palpated it from a distance with her antennæ and then remained standing for some time without touching it. Apparently she was in doubt about the object and afraid to feel of it again. When a beetle crept about on a *fusca* the latter sometimes (but rarely), moved impatiently, but did nothing more. The beetle feeds on dead and wounded ants. I saw it repeatedly perched on the abdomen of such ants, boring with its head and fore feet into a wound and remaining in this position for some time." Wasmann (1908) made similar observations on a speci-

men of *H. ferrugineus* placed in a mixed colony of *F. exsecta* and *fusca*. In this case, however, the ants licked the beetle more frequently and effusively.

These and other observations have led Wasmann to regard *H. ferrugineus* when nesting with *F. fusca* as a synœkete, or indifferently tolerated guest. Janet (1897), too, who observed the beetle in artificial nests of the same ant, came to a similar conclusion. He found the beetle mating during July and during June making attempts to escape from the nest.

The following observations, however, prove that in nests of *Lasius alienus* the relations between the beetle and the ants are much closer and more in the nature of symphily. Escherich (1897), who studied these insects in Asia Minor, says: "I kept six of these beetles and a few *Claviger* for eight weeks in an artificial nest and would summarize my observations as follows: The *Heterii* are true guests or closely allied to the true guests, as Wasmann has already stated. The ants often lick the beetles, their pygidium, wing covers, etc., as I have repeatedly and clearly discerned under a lens. As a second fact in support of this opinion, I may state that *Heterius* is not infrequently carried about by the ants, an occurrence which has been observed in many true guests (*Claviger*, *Paussus*, etc.). This transportation, which is perhaps best interpreted as a kind of 'play' or 'practice,' indicates that the ants, when attacked, or when moving to a new nest, carry their guests with them, just as they carry their larvæ and pupæ on such occasions. . . . Before leaving *Heterius*, let me relate a little episode from the life of this Histerid. On uncovering the nest I saw an ant attempting to seize one of the beetles. Time and again she made the attempt, but her mandibles kept slipping from the beetle's polished, chitinous integument. Finally she succeeded in seizing the stranger by the leg and was thus enabled to carry it a short distance, till it suddenly slipped out of her jaws. Thereupon she made no further attempts to seize it with her mandibles, but rolled it along a considerable distance with her fore feet, as if it were a barrel, while it kept its legs closely applied to its body."

Although the typical hosts of *H. ferrugineus* are Camponotine ants of the genus *Formica*, some of the North African species have been found in the nests of Myrmicinæ. *H. plicicollis* Fairmaire lives with *Aphaenogaster striola*, according to Bedel (Wasmann, 1894), and *H. chobauti* Thery with *Monomorium salomonis* (Thery, 1897). Other species,

according to Lewis (1889), live with *Aphanogaster testaceopilosa*, and, according to Lucas (1855), *H. cavisternus* is found in the nests of *Messor barbarus*.

Our American species are nearly always found in the nests of *Formica* species, as shown by the following records:

1. *H. blanchardi* Lec. — Recorded from a nest of *Aphanogaster fulva* by Schwarz (1890).

2. *H. morsus* Lec. — Taken in a nest of *F. fusca* var. (probably *argentata*) at West Cliff, Colorado, by Cockerell (1890).

3. *H. horni* Wickham. — Taken during May by Wickham (1892) in the nest of *F. schaufussi* at Cheyenne, Wyoming.

4. *H. minimus* Fall. — Taken during March at Boulder, Colorado, by Cockerell in a nest of *Lasius niger* var. *americanus*.

5. *H. tristriatus* Horn. — Schwarz (Wasmann, 1894) mentions this species as occurring in nests of *F. fusca* var. *subaenescens* in Colorado, and of *F. obscuripes* in the District of Columbia. The latter locality is probably a *lapsus calami* for British Columbia, since *F. obscuripes* does not occur in the Atlantic States and *H. tristriatus* is likewise a western insect. Schwarz (1890) also cites this beetle as occurring with *F. schaufussi* at Helena, Montana. Brues (1903) has figured a specimen taken by Professor H. Heath in a nest of *F. subpolita* at Pacific Grove, California.

6. *H. brunneipennis* Rand. — This beetle appears to be confined to the Eastern States and has been taken only in the nests of our common species of *Formica*. It is cited by Schwarz from nests of *F. fusca* (evidently var. *subsericea*) and I have taken it both with this ant in New York State and with *F. neocinerea* in Illinois (1902). Blanchard and Liebeck (1891) have encountered it in the larger mounds of *F. exsectoides*.

H. brunneipennis is the only one of our American species whose habits have been briefly noticed, and the only account of these which I have seen, is the following note published by Liebeck some years ago: "A recent addition to the collection at the Academy of Natural Sciences of Philadelphia is a hill of the mound-building ant, *Formica exsectoides*, from the vicinity of Altoona, Pa., containing a living colony of ants, measuring about three feet in diameter at the base and about two feet high. It is remarkable, considering the size, that over two hundred examples of *Heterius brunneipennis* have been captured upon the exterior of the hill, seemingly creating a doubt as to whether

it is really a colony of ants, or one of *Hetærius*. The first specimens were observed by Mr. W. J. Fox, on March 30, 1891, and since then the writer has taken small lots at intervals of three or four days, covering a period of six weeks, the specimens gradually getting less abundant. The lower half of one side of the mound, which is almost perpendicular, is completely honey-combed by exposed galleries, and out of these occasionally one or two *Hetærius* would suddenly make their appearance and roll to the bottom of the hill. Apparently the ants had carried these to the open ends of the galleries and unceremoniously tumbled them out. A great many times ants were observed emerging from the galleries with *Hetærius* in their jaws, which they would carry a short distance from the mound and drop, the ants returning without giving them any further attention. Nearly all the *Hetærius* that were seen in motion, were intent upon entering the hill, but were usually bottled before they could do so. Sometimes the *Hetærius*, when touched with a wisp of straw, would double up their members and drop, feigning death after the manner of other members of the family. At other times when touched they would display considerable activity, and although awkward and unwieldy in appearance could run along quite rapidly. An examination of small heaps of dead ants in the extreme corners of the table, upon which the mound had been placed, failed to discover the presence of any *Hetærius*."

During the past April I repeatedly found specimens of *H. brunneipennis* in nests of *F. subsericea* near Bronxville, Westchester County, New York, but never in such numbers as reported by Liebeck. In most instances a colony contained only one or two beetles, more rarely from five to a dozen. In many of these colonies there were also numerous specimens of the little Silphid synœkete, *Ptomophagus parasita* Lec. April 12 seven *Hetærii* were placed in an artificial nest with a number of *F. subsericea* workers and larvæ and kept under observation till June 30. The following notes show very clearly that the relations of these beetles to the ants are in several particulars unlike those described by Wasmann, Janet and Escherich for the European *ferrugineus*. Although the golden-yellow trichomes are scattered over the elytra and thorax of *H. brunneipennis* (Fig. 1) and not collected in masses on the sides and front of the thorax, as in some of the species from the Western States (*e. g.*, *H. tristriatus*), these structures nevertheless powerfully attract the ants. The beetles run about the nest with surprising agility, considering the awkward shape of

their body and legs, or stand motionless with the anterior part of the body elevated and the fore pair of legs raised from the floor, turned forward and strongly flexed at their femorotibial joints. When a beetle in this position happens to be touched by the antennæ of a passing ant, it begins to wave its fore legs as if to attract attention. The ant stops, begins to lick the beetle or seizes it with her jaws. The body of the latter being very hard and smooth slips from her

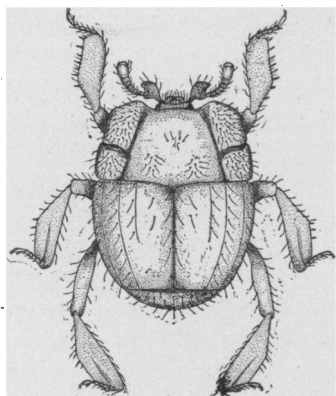


FIG. 1. *Heterius brunneipennis*
Rand. $\times 16$.

grasp but the ant redoubles her efforts. She either seizes it by one of its legs, since the beetle does not feign death and withdraw its appendages, but allows itself to be carried about the nest, or she stops, seizes it with her fore feet and, holding it in a vertical position, proceeds to lick its head in a very quick and effusive manner. For some time the beetle keeps its head withdrawn into its thorax, after the Histerid fashion, till the ant stops abruptly, protrudes her tongue and regurgitates a drop of food on its face. Then the beetle protrudes

its head, opens its mouth, works its jaws and rapidly absorbs the liquid which sometimes floods the whole cavity in the fore part of the thorax. Thereupon the ant again falls to licking the beetle as if to wipe its face free from the moisture and either leaves the creature to its own devices or regurgitates another drop. Again and again the licking and feeding may alternate as if the ant were fascinated with her pet and could not feed and fondle it enough. This performance is, in fact, so frequently repeated that I could nearly always observe it whenever I uncovered the nest. I have rarely witnessed a more comical sight than the behavior of these slender, black ants while they are holding the chunky, little, red urchins in their jaws and pouring liquid into them as if they were so many casks. Comical, too, is the behavior of the beetle while it is waiting to be noticed, with its head and fore legs elevated. At such times it assumes a ridiculous, cocky air and often, instead of receiving the caress and food which it is expecting, it is inadvertently knocked over onto its flat back by

some scurrying ant intent on more important business. Then the beetle lies for a few moments with sprawling legs but soon succeeds in righting itself and either scampers away or at once strikes its favorite attitude again. It seems to be greatly aided in the righting movements by the peculiar position of its tarsi, which are strongly flexed backward on the tibiae, so that when it is lying on its back, the claws are brought into the most advantageous position for taking hold of the floor of the nest.

Like the European *ferrugineus*, *H. brunneipennis* also feeds on solid substances. It eagerly seeks out any dead or wounded ants on the refuse heap of the nest and may be seen gnawing at their joints or mouth-parts or eating its way into the soft parts of the gaster after having made a large hole in the chitinous investment. It will also spend hours gnawing away with its sharp little mandibles at the bodies of caterpillars and other insects that have been partially eaten by the ants. Occasionally the body of a single small caterpillar or dead ant will be covered with the beetles, all busily feeding. At such times the ants often come up, tear them away and feed them with regurgitated food. The beetles straighten up and patiently submit to the fondling, licking and feeding, but as soon as the ants move away, return to their ghoulish repast.

May 31 I introduced two living *Thecla* caterpillars into the nest and observed them in the act of exuding droplets of liquid from the mouth-like orifice in the mid-dorsal line of their penultimate segment. The ants eagerly imbibed these droplets and, to my surprise, some of the *Heterii* crawled up onto the backs of the caterpillars, detected the gland and drank the exuding liquid. By the following day one of the caterpillars had pupated and had been deposited on the refuse heap, the other had been killed and reduced to a shriveled skin by the hungry ants. At this skin the beetles were busily gnawing when I uncovered the nest.

The beetles never made any attempts to leave the nest but seemed to be well satisfied with their board and lodgings. May 31 two of them were *in copulâ*, but no eggs nor larvæ were subsequently seen. Towards the latter part of June the beetles died off one by one till June 30, when only a single individual survived. On this date I was compelled to discontinue my observations.

The foregoing notes show that *H. brunneipennis* of the Eastern United States is a true symphile, since, unlike the European *ferrugineus*, it is treated with marked friendliness and is actually fed by its

hosts. That it nevertheless retains its synœketic habits intact is shown by its feeding on the insect refuse in the nest. These habits are probably very useful in enabling the beetle to live in colonies of indifferent or even hostile hosts. Schwarz and Wasmann have noticed the great development of the trichomes in the *Hetærii* from the Western States and have naturally concluded that these species are in all probability true symphiles. It is, indeed, probable that their relations to their hosts are even more intimate than those of our eastern *brunneipennis* to *F. subsericea*. If this should prove to be the case, the genus *Hetærius* would exhibit an interesting series of ethological stages, beginning with synœketes like the European *ferrugineus* in *fusca* colonies, passing into a sub-symphilic stage in this same species when living with *L. alienus* and exhibiting a more perfect symphily in *H. brunneipennis* and especially in the species of the Western States. Our meager knowledge indicates that the numerous other myrmecophilous Histeridæ that have been recorded by various authors, are mainly, if not exclusively, synœketes or synechthrans, that is, insects living in the nests of ants as indifferently tolerated or as persecuted intruders. These furnish an interesting subject for future observation and comparison.

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